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(54) Title: MINERAL FIBRE

(57) Abstract

The invention concerns an iron poor mineral fibre having a high temperature resistance. The mineral fibre has the following composition in % by weight: SiO_2 35 - 45, Al_2O_3 18 - 25, TiO_2 0 - 3, MgO 12 - 20, CaO 10 - 20, $Na_2O + K_2O$ 0 - 3, iron (Fe_2O_3+FeO) 0 - 3, B_2O_3 0 - 3, P_2O_5 0 - 4, other 0 - 3, whereby the sum of FeO + MgO ≥ 15 % by weight.

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Mineral fibre

The present invention relates to a fiberizable mineral composition as well as mineral fibres made therefrom which have a high temperature resistance.

Mineral fibres made by melting and centrifuging of a mineral raw material, such as rock, slag or similar, are used to a high degree for the manufacture of mineral fibre mats and blankets, primarily for heat and sound insulation purposes in the construction industry. In addition to the manufactured mat exhibiting a good insulating capacity against heat and sound, one has recently started to pay more attention to the properties of the mat also from a labour hygienic point of view.

A wide selection of insulating products are available on the market which exhibit not only different heat insulating properties, but also a varying degree of temperature resistance. Temperature resistant mineral fibre products are intended to mean products which can resist elevated temperatures under prolonged periods of time without changing shape or dimensions to any higher degree. Such products are thus attractive from a fire prevention point of view.

Conventional glass fibre is temperature resistant at temperatures up to appr. 550°C, whereas the temperature resistance of conventional rock wool is better, up to appr. 700°C. There is, however, an interest in products having an even higher temperature resistance, up to 1100-1200°C, and such products are also available on the market.

Such temperature resistant fibre products contain as the main oxides silicium oxide SiO_2, and aluminium oxide, Al_2O_3, and in addition often an earth alkaline metal oxide, such as calcium oxide, CaO, or magnesium oxide, MgO. In addition, such products can contain varying amounts of other oxides, such as titanium oxide, TiO_2, manganese oxide, MnO, boron oxide, B_2O_3, zirconium oxide, ZrO_2, chromium oxide, Cr_2O_3, the alkali oxides sodium and potassium oxide, Na_2O and K_2O, as well as contaminants. As examples of known art relevant in this connection, reference is made, for example, to US 4,461,840 and DE OS 1 496 662.

According to the last mentioned publication, an especially advantageous composition is obtained when the raw material melt contains appr. 4 - 12 % of iron oxides. In the mineral melt, the iron oxides are primarily present as divalent iron (appr. 75-90%) and to a lesser degree in the form of trivalent iron (appr. 25-10%). The iron content of the mineral melt is a consequence of the fact that many economically attractive raw materials contain iron to higher or lower degree. The presence of divalent iron has an advantageous effect on the temperature resistannace of the fibre, its presence for this reason being beneficial. However, in recent times, one has seriously started to pay attention to the possible toxic effects of iron in mineral fibres, especially in fibres which in addition to temperature resistance have an increased solubility in biological fluids.

Due to the toxicity risk, there is thus a need to minimize the total content of iron in mineral fibres. This, however, leads to an impairment of the temperature resistance.

According to the present invention the problem relating to decreased temperature resistance when using small amounts of iron has been solvend in a mineral fibre composition, which contains as the main oxides silicium dioxide, aluminium oxide and calcium oxide. The problem has been solved by compensating the absence or the low level of divalent iron by including in such a composition magnesium oxide in an amount so that the total amount of magnesium oxide MgO and iron oxide FeO is at least 15 % by weight. In this way a mineral fibre composition is obtained which is both temperature resistant and has low toxicity.

More specifically, the invention refers to a mineral fibre which has the following composition in % by weight

SiO_2	35	-	45
Al_2O_3	18	-	25
TiO_2	0	-	3
MgO	12	-	20
CaO	10	-	20
$Na_2O + K_2O$	0	-	3
iron (Fe_2O_3+FeO)	0	-	3
B_2O_3	0	-	3
P_2O_5	0	-	4
other	0	-	3

whereby the sum of FeO+ MgO $\geq$ 15 % by weight.

The denomination "other" components above encompasses such possible contaminants which are not of substantial importance for the properties of the manufactured fibre.

It is known that within the range 0 - appr. 15 % the aluminium oxide content is direct proportional to the stability of the fibre in biological solutions, that is the more aluminium oxide the composition contains, the more stable or poorly soluble is the product. However, at a higher level, the tendency becomes reversed so that the solubility of the fibre increases in relation to the aluminium oxide content. According to the invention, a fibre has thus been made having a good heat resistance but a low toxicity and a high solubility in biological solutions.

Preferably the composition contains essentially equal amounts of MgO and CaO. According to a further preferred embodiment, the sum FeO + MgO + CaO $\leq$ 32 % by weight.

According to a preferred embodiment, the invention concerns a fibre having the following composition in % by weight

SiO_2	38	-	42
Al_2O_3	18	-	22
TiO_2	1	-	3
MgO	14	-	18
CaO	14	-	18
$Na_2O + K_2O$	0	-	2
iron (Fe_2O_3+FeO)	1	-	3
B_2O_3	1	-	2
P_2O_5	1	-	2
other	0	-	2

whereby FeO + MgO $\geq$ 15 % by weight.

According to a very special embodiment, the invention refers to a fibre containing substantially

SiO_2	38
Al_2O_3	20
TiO_2	2
MgO	15
CaO	15
$Na_2O + K_2O$	1
iron (Fe_2O_3+FeO)	3
B_2O_3	2
P_2O_5	2
other	2.

The mineral composition is made in a conventional manner by mixing suitable raw material a such as stone, sand, dolomite, apatite, olivine, glass, or various slags and other suitable waste materials in suitable proportions. According to a preferred embodiment, the predominant raw material is slag fom iron manufacture, as such a product in itself is already iron poor. The desired increased alu-

minium oxide content can be obtained by adding suitable aluminium containing raw materials, for example bauxite, in suitable amounts. Mineral fibres are manufactured from the composition in a conventional manner, for example using cascade centrifugation.

The following example illustrates the invention without restricting the same.

Example

Example

In a cupola furnace the following components are charged having the compositions indicated in the table, in the amounts indicated in % by weight.

	Calc. bauxite	Quartz sand	Slag	Apatite	Olivine sand
amount: component:	20.0	14.0	33.0	5.0	28.0
SiO_2	5.0	99.1	36.0	3.2	42.0
Al_2O_3	86.5	0.6	9.0	0.3	0.5
TiO_2	4.0	0.0	1.0	0.0	0.0
MgO	0.0	0.0	10.2	0.5	49.3
CaO	0.0	0.0	37.8	50.8	0.0
Na_2O+ K_2O	0.3	0.1	1.1	0.0	0.0
iron	1.9	0.1	0.3	0.8	7.1
B_2O_3	0.0	0.0	0.0	0.0	0.0
P_2O_5	0.2	0.0	0.0	33.0	0.0
other	0.0	0.1	1.1	8.3	1.1

From the melt obtained fibres are made in a conventional manner by cascade centrifugation, which fibres are collected onto a conveyor to form a mineral fibre mat. The mineral fibres have the following composition.

SiO_2	40.0
Al_2O_3	21.2
TiO_2	1.2
MgO	17.8
CaO	15.5
$Na_2O + K_2O$	0.4
iron (Fe_2O_3+FeO)	1.7
B_2O_3	0
P_2O_5	1.7
other	0.5.

Claims

1. Mineral fibre, characterized in that it has the following composition in % by weight:

SiO_2	35	-	45
Al_2O_3	18	-	25
TiO_2	0	-	3
MgO	12	-	20
CaO	10	-	20
$Na_2O + K_2O$	0	-	3
iron (Fe_2O_3+FeO)	0	-	3
B_2O_3	0	-	3
P_2O_5	0	-	4
other	0	-	3

whereby the sum FeO+ MgO $\geq$ 15 % by weight.

2. The mineral fibre according to claim 1, characterized in that it contains substantially equal amounts of MgO and CaO.

3. The mineral fibre according to claim 1 or 2, characterized in that the FeO + MgO + CaO $\leq$ 32 % by weight.

4. The mineral fibre according to claim 1, 2 or 3, characterized in that it has the following composition in % by weight:

SiO_2	38	-	42
Al_2O_3	18	-	22
TiO_2	1	-	3
MgO	14	-	18

CaO	14	-	18
$Na_2O + K_2O$	0	-	2
iron (Fe_2O_3+FeO)	1	-	3
B_2O_3	1	-	2
P_2O_5	1	-	2
other	0	-	2

whereby FeO + MgO $\geq$ 15 % by weight.

5. The mineral fibre according to claim 4, **characterized** in that it has substantially the following composition in % by weight:

SiO_2	38
Al_2O_3	20
TiO_2	2
MgO	15
CaO	15
$Na_2O + K_2O$	1
iron (Fe_2O_3+FeO)	3
B_2O_3	2
P_2O_5	2
other	2.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 97/00096

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: C03C 13/00, C03C 13/06
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: C03C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 8705007 A1 (MANVILLE CORPORATION), 27 August 1987 (27.08.87), page 10, line 1 - line 16	1-5

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 8705007 A1	27/08/87	AU 590393 B	02/11/89
		AU 6948887 A	09/09/87
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